

## Claims

We Claim:

- 1) A composition of matter comprising an aerogel having a monolayer coating.
- 2) The composition of matter of claim 1, wherein said aerogel is a ceramic oxide.
- 3) The composition of matter of claim 2, wherein said ceramic oxide is selected from the group consisting of silica, alumina, aluminosilicate, and combinations thereof.
- 4) The composition of matter of claim 1, wherein said monolayer coating is formed of self-limiting monomers.
- 5) The composition of matter of claim 4, wherein said self-limiting monomers are selected from the group consisting of alkyl silanes, chlorosilanes, boranes, chloroboranes, germanes, and combinations thereof.
- 6) The composition of matter of claim 1 wherein said aerogel having said monolayer coating has pore sizes of between 150 Å and 250 Å and bottlenecks of between 110 Å and 150 Å.
- 7) A composition of matter comprising a ceramic oxide aerogel having a monolayer coating consisting essentially of a self-limiting monomer.
- 8) The composition of matter of claim 7, wherein said ceramic oxide is selected from the group consisting of silica, alumina, aluminosilicate, and combinations thereof.
- 9) The composition of matter of claim 7, wherein said self-limiting monomer is selected from the group consisting of alkyl silanes, chlorosilanes, boranes, chloroboranes, germanes, and combinations thereof.
- 10) The composition of matter of claim 7, wherein said ceramic oxide aerogel having said monolayer coating has pore sizes of between 150 Å and 250 Å and bottlenecks of between 110 Å and 150 Å.
- 11) A method for forming an aerogel having a monolayer coating comprising the steps of:
- a. providing an aerogel and a monolayer forming precursor in a supercritical fluid,

- b. reacting said aerogel and said monolayer forming precursor in said supercritical fluid to form a covalent bond between said aerogel and said monolayer forming precursor.
- 12) The method of claim 11, wherein said aerogel is provided as a ceramic oxide.
- 13) The method of claim 11, wherein said ceramic oxide is provided as selected from the group consisting of silica, alumina, aluminosilicate, and combinations thereof.
- 14) The method of claim 11, wherein said monolayer forming precursors are provided as self-limiting monomers.
- 15) The method of claim 14, wherein said self-limiting monomers are provided as selected from the group consisting of alkyl silanes, chlorosilanes, boranes, chloroboranes, germanes, and combinations thereof.
- 16) A method for forming an aerogel having a monolayer coating comprising the steps of:
- a. providing an aerogel, a surface preparation agent, and a monolayer forming precursor in a supercritical fluid,
- b. reacting said aerogel, said surface preparation agent and said monolayer forming precursor in said supercritical fluid to form a covalent bond between said aerogel and said monolayer forming precursor.
- 17) The method of claim 16, wherein said aerogel is provided as a ceramic oxide.
- 18) The method of claim 16, wherein said ceramic oxide is provided as selected from the group consisting of silica, alumina, aluminosilicate, and combinations thereof.
- 19) The method of claim 16, wherein said monolayer forming precursor is provided as self-limiting monomers.
- 20) The method of claim 19, wherein said self-limiting monomers are provided as selected from the group consisting of alkyl silanes, chlorosilanes, boranes, chloroboranes, germanes, and combinations thereof.
- 21) A method for forming an aerogel having a monolayer coating comprising the steps of:
- a. hydroetching an aerogel to provide a hydroetched aerogel,

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b. providing said hydroetched aerogel with a monolayer forming precursor in a supercritical fluid,

c. reacting said hydroetched aerogel and said monolayer forming precursor in said supercritical fluid to form a covalent bond between said hydroetched aerogel and said monolayer forming precursor.

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22) The method of claim 21, wherein said aerogel is provided as a ceramic oxide.

23) The method of claim <sup>22</sup>21, wherein said ceramic oxide is provided as selected from the group consisting of silica, alumina, aluminosilicate, and combinations thereof. *L*

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24) The method of claim 21, wherein said monolayer forming precursor is provided as self-limiting monomers.

25) The method of claim 24, wherein said self-limiting monomers are provided as selected from the group consisting of alkyl silanes, chlorosilanes, boranes, chloroboranes, germanes, and combinations thereof.

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